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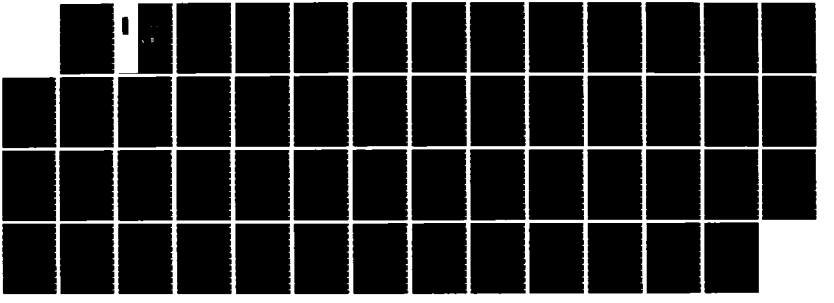

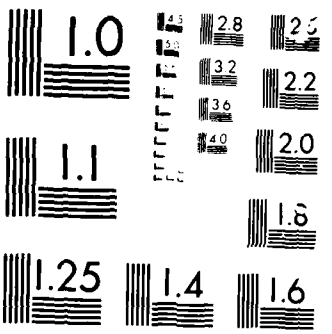
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# Annual Report

# 1984





## Center for Naval Analyses

A Division of Hudson Institute

The CENTER FOR NAVAL ANALYSES is a non profit Federal Contract Research Center (FCRC) that traces its origins to 1942, when the Anti-Submarine Warfare Operations Research Group was created to help defeat the U-boats. CNA's current efforts for the Navy and Marine Corps range widely, from support of training and testing activities in the fleet to the evaluation of future technologies, forces, and strategies for top-level decision-makers in Washington. Research is conducted mainly in CNA's four line divisions: Naval Warfare Operations; Naval Planning, Manpower, and Logistics; Marine Corps Programs; and Field Operations. CNA's research program is shaped in consultation with the Department of the Navy's Policy Council for CNA, which is chaired by the Assistant Secretary of the Navy for Research, Engineering and Systems

Under CNA's matrix organization, the expertise that enables the divisions to do relevant and timely analyses of high quality is developed through six research departments: Air Warfare, Surface Warfare, Submarine and Antisubmarine Warfare, Amphibious and Land Warfare, Policy and Resources, and Information Sciences. The departments support methodological research, provide training and career development opportunities in the various specialties, and perform quality-control functions.

CNA's professional staff numbers 180. Of the professional staff, 90 percent hold advanced degrees and about half have served as CNA field representatives. On average, members of the professional staff have 10 years' experience in defense analysis. The experience of the civilian staff is augmented by that of the 18 Naval officers who are assigned to work in CNA's research program

In 1983, following a competition among several institutions, the Department of the Navy selected the Hudson Institute to manage CNA.

The Hudson Institute, founded in 1961 by the late Herman Kahn, is a non-profit organization dedicated to the examination of critical issues of policy in the public interest. The Institute serves as a research bridge between organizations that may be too close to problems to analyze them objectively (e.g., government agencies) and those that may be too far removed to evaluate them effectively (e.g., academic institutions).

Hudson's studies cover a wide variety of global, national, regional, and local issues, from narrowly professional concerns to problems common to an entire industry, country, or group of nations. There are five basic areas of study at the Hudson Institute: national security and international order, energy and natural resources, American domestic issues, economic issues, and studies of the future. Hudson's most enduring concentration has been in the areas of national security policy and arms control. The Institute's more recent studies have focused on military technology, mobilization, protracted war, Soviet and European trends in national security policy, and the changing role of the U.S. Navy.

# Annual Report

# 1984

**Center for Naval Analyses**
*a division of Hudson Institute*
4401 Ford Avenue
Alexandria, Virginia 22302-0268

# Foreword

Fiscal Year 1984 marked a new beginning for the Center for Naval Analyses. At the start of the year, CNA became a division of Hudson Institute. By the end of the year, CNA had made significant progress toward Hudson's main goals for it, which are to:

- Quickly respond to the vital analytical needs of the Navy and Marine Corps
- Develop and maintain the expertise needed to respond with research of the highest quality.

The essay in part I of this report expands on this philosophy; several practical steps have been taken to implement it. For example, communication between CNA's top management and the senior civilian and uniformed leaders of the Navy and Marine Corps is at an all-time high. This exchange of ideas has significantly improved CNA's ability to respond to the services' analytical needs and priorities. These interactions are paralleled by more frequent consultations between CNA analysts and their immediate clients in the Navy and Marine Corps. These consultations generate constant feedback, which ensures the relevance and realism of CNA's work. The sample of results in part II gives only a hint of the many ways CNA analysts helped the Navy and Marine Corps come to grips with critical issues in FY 1984.

A new research planning process, worked out with the Navy and Marine Corps, has helped improve both the quality and relevance of CNA's work. The new process, described in part III, differs from the old one in two major respects. First, a new 12-month plan is prepared every quarter. As a result, near-term goals are continuously updated to reflect progress and revised priorities, while longer-term goals and commitments are kept in view. Second, CNA initiates the plan, to preserve continuity of effort and to ensure that commitments can be backed by expertise. The final details of the plan, of course, are worked out with the Navy and Marine Corps. Moreover, CNA solicits ideas directly from the services, and the CNA staff members who contribute to the plan draw, in turn, on their contacts in the services.

To foster the expertise needed to execute the research plan, Hudson revised CNA's organization after a detailed review by a special team of experts in naval matters, analysis, and management. A key component of the new organization, described in part IV, is the research department.

Each of our six departments specializes in a particular warfare or support function. Through project work and a new training program, the departments' experienced analysts impart to new analysts their working knowledge of the operations, systems, and forces of the Navy and Marine Corps.

Much of that knowledge has been gained through CNA's field program, also described in part IV. A mainstay of the organization since its beginnings in 1942, the field program has been refocused to give the Navy and Marine Corps more analytical help in the development and evaluation of tactical, operational, and strategic concepts.

CNA's ability to help the Navy and Marine Corps depends, finally, on the funding it receives and on the calibre of the staff it can maintain with that funding. Part V tells about CNA's finances in FY 1984 and describes the qualifications of the professional staff, as well as the support they get from the rest of the organization. In the last half of FY 1984, the professional staff grew from 157 to 168, as part of a buildup that should see the staff's size go above 200 by the end of FY 1985.

One of CNA's most valuable resources is its Board of Overseers, whose members are listed on the facing page. This distinguished new Board, appointed by Hudson, has been an active one. The Board's guidance and support have been instrumental in the revitalization of CNA. The Board has formed sub-panels known as Technical Advisory Committees – one for each of CNA's four operating divisions. The TACs meet regularly to review the accomplishments of the divisions and to give advice about new areas for fruitful work.

On behalf of the Board of Overseers, I am proud to submit this report of CNA's first year as part of Hudson Institute.

Thomas D. Bell, Jr.
President and Chief Executive Officer, Hudson Institute
Chairman, CNA Board of Overseers

## CNA BOARD OF OVERSEERS

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*Former Commandant, United States Marine Corps*

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**R. James Woolsey**
*Partner, Shea & Gardner*
*Former Under Secretary of the Navy*

**Charles A. Zraket**
*Executive Vice President, The MITRE Corporation*

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*Secretary to the Board* **William L. Bell, Jr.**

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# I. The defense debate and the role of analysis

The public debate about the nation's defense posture has rarely intersected with the debate over a more obscure issue: the role of analysis in defense decision-making.

To be sure, the main issue in the larger debate – how much to spend for defense – is one about which analysis has had little to say. The "consensus" about how much to spend shifts with general perceptions about the threat to the nation's well-being and the desirability of spending for other purposes.

Some commentators do try to couple the *amount* of defense spending with the *way* defense funds are spent, and the *way* available forces are used. There are those who argue, for example, that the defense budget can be reduced without risk if only we will buy the right kinds of forces and use them to greater advantage. But they represent a line of thought that lies outside the mainstream of traditional defense analysis. Their judgments are essentially subjective ones, backed up by the selective use of quantitative evidence.

The essential task for mainstream analysis is not to argue for the "best" level of defense spending or the "best" mix of defense forces, but to provide a factual basis upon which decision-makers can search for better forces and better ways of using them. The purpose of this essay is to reaffirm the empirical foundations of defense analysis.

## NEW "PLENTY" AND FAMILIAR CHOICES

Since 1979, spending for national defense has risen, in real terms, by almost 50 percent – a compound, annual increase of 8 percent. This growth has been traced to such causes as the unrelenting rise in Soviet military spending, even when our own had stagnated, and signs of the Soviets' greater willingness to threaten force (Poland) and to use force (Afghanistan) to advance their interests.

Putting aside the question whether U.S. defense spending has grown too much – or not enough – there is no question about the need to spend wisely. The preparation of an annual budget gives officials of the Depart ment of Defense the opportunity to reassess the balance among the various military missions and the types of forces associated with each, between today's technology and tomorrow's, between numbers of forces and their readiness for combat, between numbers of forces and the length of time they can fight, and

among all of these parameters of military strength.

The rise of defense spending, of course, has made it possible to add forces, to invest in more new technology, and to improve the readiness and sustainability of forces – all at once. In the 1980s, for example, the Navy has:

- Increased the number of its active and reserve ships by about 50
- Increased its rate of new ship construction and aircraft procurement by about 25 percent
- Increased the annual rate of growth in funding for readiness from 1 percent to 6 percent
- Increased the annual rate of growth in funding for sustainability from 2 percent to 11 percent.

These were not the only, or necessary, choices; other allocations were considered. Regardless of how much money is available, striking the "right" balance in the allocation of budgets – to be better prepared for the future – remains a difficult task for the civilian and uniformed leaders of the Department of Defense. An equally important and difficult task is preparing for near-term threats to peace by finding better ways to use the forces and systems at hand.

In sum, the essential choices faced by policy-makers and force commanders remain unchanged, in spite of changes in budgets, technologies, and threats. Relative plenty does not ease the process of choosing among competing demands for the use of funds. Neither relative plenty nor relative peace erases the operational commander's need to find better ways of using his forces in combat.

## THE ROLE OF ANALYSIS, RECONSIDERED

Because of the complexity of the choices involved in allocating funds and operating forces – and because of the great uncertainty that inevitably surrounds those choices – defense decision-makers have turned often to the analytical community for help. In recent years, some decision-makers have questioned whether they have gotten the right kind of help. As R. James Woolsey – a former Under Secretary of the Navy and a member of CNA's Board of Overseers – put it:

> For about two decades, the intellectual furniture that has been brought to decision-making in the Department of Defense...has been pretty much of one style.... It goes by many names – program analysis or systems analysis, among others.... It is highly quantitative, focused on weapons programs, and rooted in the disciplines of economics and the techniques of the business schools. Its primary tenets are to concentrate on objectives, criteria, and options, to quantify as much as possible, and to focus on changes at the margin

> One should assess the systems analysis approach as a method of decision-making.... [O]ne should ask whether...it still deserves the allegiance that has been paid to it for nearly two decades now and whether, as a tool of decision-making, it may itself involve certain costs and cause certain blind spots.[1]

A major blind spot has been the belief that valuable "insights" flow automatically from the mere observance of the systems-analysis formula – develop alternatives, select criteria by which to compare them, and concoct models by which to measure the alternatives against the criteria – whether or not the alternatives, criteria, and models are operationally meaningful or factually based.

The cost of this blind spot has been a tendency to overlook, if not denigrate, operational experience that cannot be expressed in terms of the systems-analysis formula. Willfully or naively, systems analysis has often been a means of passing judgment on the views of defense decision-makers (particularly military officers), rather than a way of helping them to sharpen their own judgment.

Put simply, the era of systems analysis – like the latter-day era of quasi-analytical commentary – represents a departure from the principles that led decision-makers to put their trust in analysis in the first place. Those principles were forged in the crucible of World War II.

## FIRST PRINCIPLES, REVISITED

In World War II, CNA's forerunner, the Operations Research Group, made successful contributions to the solution of the Navy's operational problems for several reasons:

First, the members of the Group brought suitable academic disciplines to the operational problems of the day. (Those disciplines were, mainly, the physical sciences and mathematics.)

Second, as civilians, they operated outside the Naval hierarchy, and could bring a detached perspective to their study of the operational problems.

Third, the value of this perspective fostered a relationship of mutual trust between the analysts and their Naval clients. The Navy divulged the information the analysts needed to get the job done. The analysts, in turn, protected the information.

1. *The Uses and Abuses of Analysis in the Defense Environment: A Conversation with R. James Woolsey*, American Enterprise Institute for Public Policy Research (Washington, D.C., 1980), pp. 3 and 4.

Fourth, in this atmosphere of mutual trust, the analysts could readily get their findings and recommendations to Navy decision-makers, who, in turn, were quick to tell the analysts what problems were most pressing. In other words, there was open communication.

Fifth, there was the field program. A large fraction of the Operations Research Group's analysts were assigned to operating bases where they could "more readily learn of operational problems and pass along proposed solutions directly to those in command." The practical knowledge gained in the field was essential to Group members in Washington, "who needed to know whether their sugges tions concerning tactics or equipment squared with the real world...."[1]

In sum, the Group was able to offer useful insights to decision-makers be cause its analysts and analyses were "toughened by the repeated impact of hard operational facts and pressing day-to-day demands," and "repeatedly tested in the acid of use."[2] Moreover, there was an understanding of the proper role of the analyst in decision-making:

> Occasionally there is some suspicion that the operations research worker wishes to take over the command function of the officer. This may come up if the findings of the operations research worker are considerably at variance with the pre-conceived opinion of the officer. This suspicion can only be overcome if both the worker and the officer realize that the results of operations research are *only* a part of the material from which final decision must be made. In any administrative decision there enter a great number of considerations which cannot be put into quantitative form (or at least cannot yet be put into this form). Knowl edge of these qualitative aspects, and ability to handle them, is the proper function of the administrator, and is *not* the prerogative of operations research. The operations research worker, unless he is to operate in a dual role of scientist and administrator, must work out those aspects of the problem which are amen able to quantitative analysis and report his findings to the administrator. The administrator must then combine these findings with the qualitative aspects mentioned above, to form a basis for the final decision. This decision must be made by the executive officer. If his decision runs counter to the scientific findings at times, the scientist must not consider that this is necessarily a repudiation of his work.

1. Keith R. Tidman, *The Operations Evaluation Group: A History of Naval Operations Analysis* (Annapolis: Naval Institute Press, 1984), p. 94.
2. Philip M. Morse and George E. Kimball, *Methods of Operations Research* (Washington, D.C.: Operations Evaluation Group, 1946), p. 10.
3. Morse and Kimball, *op. cit.*, p. 9.

## BROADER PROBLEMS, MORE ELUSIVE SOLUTIONS

Since World War II, analysis has been applied to a broader range of problems than the improvement of tactics and assessment of operations. Accordingly, analysts with a broader range of backgrounds – economists, psychologists, and political scientists, for example – have joined the mathematicians and physical scientists of World War II. Today, analysts are also charged with:

- Assessment and projection of enemy strategies and forces, present and future
- Formulation and evalution of alternative U.S. military strategies
- Assessment of the ability of forces to execute the approved strategy and its derivative missions
- Evaluation of alternative future forces and systems, for specific missions and tasks
- Development of efficient manpower policies and logistics operations, to support the forces
- Integration of all these elements into coherent, multi-year spending programs.

Such challenges have been compli cated by changes in the instruments of warfare. In naval warfare, for example, we have gone from guns and bombs to missiles, from radios to satellites, from eyeballs to imaging radars, from chaff and underwater noisemakers to a spectrum of electromagnetic devices, and from the finger on the trigger to the onboard computer.

But perhaps the most significant change in the climate for analysis is the absence of war – the lack of an "acid test" for the analyst's recom mendations about strategies, forces, systems, and tactics. Even man power, logistics, and management studies that help to foster peacetime efficiency may prove detrimental to wartime effectiveness.

For want of an "acid test," practices of the type criticized by R. James Woolsey and other informed commentators have become commonplace. Narrow, quantitative criteria have acquired too much currency in the decision process. The search for optimality at the margin has lent too much weight to insigni ficant quantitative differences – the "best" has often been the enemy of the "good." Some analysts have invited further scorn by being pseudo-scientific and implausibly precise about matters of which they have no

first-hand knowledge and for which data are sparse or nil.

## FIRST PRINCIPLES, REAFFIRMED

The remedy for past abuses is not to reject quantitative analysis of defense issues but to reaffirm the principles that made quantitative analysis valuable to begin with. The challenges facing the nation's military forces are too great to go unanalyzed. Recent conflicts have reminded us of the real contributions that analysis can make to a nation's defenses.

In the air battles between Israeli and Syrian forces in 1982, for instance, the Israelis successfully coordinated the use of remotely piloted vehicles, electronic countermeasures, chaff, and air-to-surface missiles to take out Syrian surface-to-air missile batteries. The Syrian air threat was evidently defeated by jamming the Syrians' communications and attacking their aircraft from the "blind side."[1] Such results suggest not only good intelligence on the part of the Israelis, but also the use of analysis to devise the tactics that exploited the intelligence.

In the battle for the Falkland Islands in 1982, the British found the need for analysis to design and carry out vital logistics operations, to assess the seriousness of the Argentine air threat, and to develop tactics against the Exocet missile.

The principle underlying these contributions, of course, is the principle enunciated by those who were present at the creation of defense analysis:

> To be valuable, [analysis] must be toughened by the repeated impact of hard operational facts and pressing day-by-day demands, and its scale of values must be repeatedly tested in the acid of use. Otherwise it may be philosophy, but it is hardly science.[2]

War or no war, analysts can best help the nation's armed forces perform their missions by adhering to the scientific practices of the past: Build only upon facts and leave judgments to decision-makers.

1. See Paul S. Cutler, "EW Won the Bekaa Valley Air Battle" and "ELTA Plays a Decisive Role in the EOB Scenario," *Military Electronics*, January 1983.
2. Morse and Kimball, *loc. cit.*

# II. 1984 results: a sampler

The projects highlighted here represent only a small part of CNA's efforts for the Navy and Marine Corps in FY 1984. The examples have been chosen to convey an idea of the range of CNA's activities and of their usefulness to the services. Many details and all classified material have been omitted for the sake of brevity and security. These are the major topics and specific projects covered:



## TODAY'S FORCES AND OPERATIONS

### Targeting Harpoon Missiles

Harpoon is the Navy's chief antiship missile, deployed on ships, submarines, and aircraft. Since the missile's introduction in 1977, CNA has been analyzing live firings and simulated engagements during exercises, to help the Navy develop the best possible tactics for its use.

In an attack on an enemy ship or formation, Navy operators use data about the target and its position to generate orders to the launcher and missile. The data may include an aimpoint for the missile, the size of the area to be searched by the missile, and the size of the salvo to be fired. While analyzing the results of simulated engagements at sea, CNA analysts discovered an omission in present shipboard firing doctrine: a lack of instructions for firing a salvo of several Harpoons at a formation of several ships. Because of the omission, some Navy operators have tended to select a single aimpoint for the salvo. Intuition suggested that a

salvo of Harpoons fired at a single aimpoint might not be an optimum choice.

CNA set out to analyze this tactical problem, building on past research. At the request of the Harpoon Project Office, CNA had previously reviewed existing models of Harpoon per formance, nearly all of which were Monte Carlo simulations of target acquisition in a Harpoon engagement. Because none of the models could be used efficiently to derive near-optimum aimpoints when more than one Harpoon is employed to attack a formation, CNA analysts constructed a new model, the Harpoon Engagement Model (HAREM).

HAREM is a computerized model that calculates the probabilities of various outcomes when several Harpoons are to be fired at a group of ships, for example, a surface action group. The model may be used in two ways. Like the models mentioned earlier, it will evaluate the effectiveness of a set of fire-control solutions proposed by the operator. And when used for evaluating effectiveness, it yields results similar to the other models. But it has this advantage: It will also derive fire-control solutions for attaining a specified tactical objective.

Because the mathematical techniques of HAREM require much less compu tational time than a Monte Carlo simulation, the model is suitable for shipboard planning of Harpoon engagements. The computer program is written in BASIC computer language on a type of minicomputer that is used widely in the fleet for tactical decision aids.

The Navy's Surface Warfare Development Center has used HAREM to obtain data for its forthcoming revision of Harpoon employment doctrine. In addition, CNA analysts are using the model to derive tactical guidance on how best to employ Harpoon against hostile formations.

### Air-Defense Tactics for the F/A-18

The F/A-18 combines the features of strike and fighter aircraft. The Navy has been considering how to use the F/A-18 in conjunction with other aircraft so that it can contribute effectively to the air defense of the battle group. Of particular interest are joint operations of the F/A-18 with F-14 fighters and E-2C early-warning aircraft.

To help provide some insight into these issues, the Navy conducted a series of war games at its Weapons and Tactics Analysis Center (WEPTAC). The games were intended to assess the relative effectiveness of various plans for positioning and employing F/A-18s to counter Soviet air forces. CNA analysts helped to construct the

simulations and evaluate their results.

Such simulations must be approached with caution; they cannot yield optimal defensive tactics or lead to tactical refinements. Accordingly, the goals of the WEPTAC games were to expose tactical weaknesses that were unknown or only suspected in the planning phase and to experiment with ways to strengthen defensive postures. To achieve these ends, the measures by which the alternative tactics were to be evaluated were kept as simple as possible, the various simulations were kept as standard ized as possible, and quantitative comparisons were reinforced by qualitative considerations.

In the simulations, a single carrier was pitted against a substantial force of Soviet Backfire and Badger bombers armed with antiship cruise missiles and accompanied by electronic-warfare aircraft. Clearly, a battle group consisting of several carriers and escorts is more surviv able and would be the force of choice. Such a force, however, may not be available at the beginning of a conflict, because of the normal peacetime dispersal of ships. Further, the single carrier ensured that there would be an abundance of targets for the simulated F/A-18 and F 14 fighters, which were armed with a mix of air-to-air missiles and supported by early-warning aircraft and tankers for inflight refueling.

The simulations examined the effects of assigning the fighters to patrol stations at various distances from the carrier (to achieve a layered defense), employing the fighters in different-sized waves, providing or denying inflight refueling, and altering the width of the area to be defended. For the enemy force, the size and com position of the bomber formations remained constant, though the paths along which the bombers approached the battle group varied.

Two main quantitative measures of effectiveness were used. The first measure was the number of bombers that succeeded in penetrating the battle group's air defenses and getting within range to launch their antiship missiles. The second was the cumula tive percentage of bombers hit by air-to-air missiles fired by the defending fighters, relative to the range of the bombers from the carrier. These two measures provided similar informa tion but from different perspectives, with both serving to assess a particular tactic's effectiveness in bringing weapons to bear upon the enemy aircraft. The qualitative measures included observations about command and control difficulties, effects of the artificialities of the simulations, problems in running the tests, and nonquantifiable judgments about the workability of each tactic.

The simulations and CNA's analysis of their results provided a better understanding of the strengths and weaknesses of tactics for the F/A-18, as it might be used under various conditions. The results of this effort have been used by the Navy in preparing a comprehensive set of tactics for evaluation by those air wings of the Second and Third Fleets that will be equipped with the F/A-18.

## Aegis in the Mediterranean

The USS *Ticonderoga*, a guided-missile cruiser, is the lead ship of its class and the first to be outfitted with the Aegis weapon system. Though capable of defending carrier battle groups against diverse enemy forces – aircraft, missiles, ships, and even submarines – *Ticonderoga*'s primary mission is antiair warfare (AAW). And Aegis is central to that mission.

Aegis has four main elements: the SPY-1 radar, used to detect and track aircraft; a command and decision system that can automatically respond to attacking missiles; a display system that gives operators considerable flexibility in displaying the tactical picture on large screens; and new, high-performance, surface-to-air missiles (SAMs) to shoot down enemy aircraft and antiship missiles. Aegis is thus designed to provide the detection and tracking capability, quick-reaction time, and high rate of fire necessary to contend with the modern air threat. Importantly, it is also designed to afford the antiair warfare commander a clear, complete surveillance of a large area.

With the initial deployment of *Ticonderoga*, Commander Sixth Fleet asked CNA to conduct an analysis of the tactical employment of Aegis and of the integration of *Ticonderoga* into Sixth Fleet operations in the Mediterranean. Because of the volatile events in Lebanon, activities that had been planned for *Ticonderoga* were shelved. Instead, the ship spent almost all of her deployment as part of a large battle force off the coast of Lebanon, supporting an amphibious replenishment group in the area and the U.S. Marines ashore.

As a result, there was no opportunity for exercises to assess *Ticonderoga* in such roles as fighter control and SAM employment. But the situation did offer an excellent opportunity to examine two essential matters that could not otherwise have been adequately evaluated: (1) the quality of the air picture produced by the SPY-1 radar and (2) the adequacy of the picture's transmission over the main data link to the other ships, and hence its contribution to the air picture shaped by the entire battle force. The presence of a multi-carrier force and the helicopters of the amphibious replenishment group – in addition to Israeli, Syrian, and

commercial aircraft – created a complex air-traffic environment that could not be duplicated in exercises.

In response to Sixth Fleet's request for analytical support, four CNA staff members took turns embarking in *Ticonderoga* throughout the deployment. These analysts recorded the air picture on board *Ticonderoga*, while computers on *Ticonderoga* and the other ships recorded the flow of air-track data between the ships. Among other things, the CNA analysts examined where tracks were first detected, how long the tracks were held, the number of tracks that had to be maintained, and whether the tracks were held continuously or were alternately picked up and lost. Further, they were able to compare the information gained from air-traffic communications during strikes by non-U.S. aircraft around Beirut with what the radar showed. In separate tests, *Ticonderoga* was deliberately taken out of the data link with other ships of the battle force, to see just how much she does contribute to air and surface surveillance. In other tests, an air target held by *Ticonderoga*'s SPY-1 radar was handed over to the fire-control radar of another guided-missile cruiser. The objective was to determine whether this procedure would permit the second cruiser to shoot at the target while its own main-search radar was turned off, jammed, or disabled.

Analysis of the data led to the conclusion that Aegis generates an excellent air picture. Indeed, the picture is remarkably free of clutter and false aircraft tracks, providing commanders with a clear view of how events are evolving. An evaluation of the data link in transmitting the air picture, however, pointed to shortcomings that need to be remedied if all the ships in a battle force are to benefit fully from the capabilities of Aegis. In sum, the analysis confirmed the technical excellence of the Aegis cruiser and its potential for greatly enhancing the coordination, command, and control of AAW operations by battle forces. The results will be used by the Navy to develop tactical guidelines for employing Aegis cruisers in future operations.

### Analyses for the Fleet Commanders-in-Chief

Since 1981, CNA has conducted a Washington-based analytical program for the Commanders-in-Chief of the Pacific and Atlantic Fleets (CINCPACFLT and CINCLANTFLT). Now, in addition to Washington-based support, CNA assigns full-time representatives to the staffs of CINCPACFLT and CINCLANTFLT.

*Pacific Fleet*

For the past three years, CNA analysts and members of the CINCPACFLT staff have worked together to produce a series of annual capabilities assessments. Each assessment covers three areas: strategy, assets assigned to CINCPACFLT and his Soviet counterpart, and outcomes of possible engagements between U.S. and Soviet naval forces.

The strategy for a general war with the Soviet Union is specified in the Chief of Naval Operations' Maritime Strategy. Although the basic strategy is fixed, operational concepts for the use of forces in the execution of the strategy are not. Through their participation in strategy seminars and war games hosted by CINCPACFLT, CNA analysts help to develop and evaluate alternative operational concepts within the overall strategy.

The forces and other assets assigned to the U.S. and Soviet Pacific Fleets change constantly. One portion of the annual assessment provides a comparison ("static assessment") of the U.S. and Soviet Pacific Fleets' forces, weapon systems, combat comsumables, and readiness. Trends in each Fleet's posture are found by comparing year-to-year changes in the static assessments.

The final step in the assessment process entails effectiveness analyses of the available forces (the "dynamic assessment"). The dynamic assessment helps in the evaluation of alternative concepts of operation. It also helps to identify any critical shortages of material, and therefore provides the basis for CINCPACFLT's statement of budgetary priorities.

*Atlantic Fleet*

CNA's efforts for CINCLANTFLT have a somewhat different focus from the work for CINCPACFLT. During the past year, a CNA analyst studied carrier battle force (CVBF) operations in the Norwegian Sea and began to investigate the effects of projected advances in Soviet air defense systems.

The Norwegian Sea analysis highlighted the factors that would most influence the effectiveness of a CVBF operating close to the Soviet Union. The analysis quantified the threats to such a force and suggested two ways the CVBF might operate to success fully defend against those threats and effectively attack Soviet targets.

Because tactical aviation is such a large part of the Navy's offensive power, it is important to understand the nature and effectiveness of Soviet air defenses. As Soviet ground and airborne AAW forces improve, the

threat to U.S. Navy tactical aircraft becomes more serious. The CNA analyst therefore began to explore ways for the Navy to overcome the future Soviet air defense system. Once more, specific attention is being given to operations in the Norwegian Sea.

## Exercise Analysis

Major fleet exercises may continue for days or even weeks, and they sometimes involve the combined forces of several battle groups. Their purpose is to train personnel, evaluate capabilities, and develop and evaluate tactics under conditions as close as possible to combat. Because of the high cost of these exercises, they are relatively infrequent. Consequently, both operators and analysts must be able to take full advantage of every exercise that is conducted.

One example of recent CNA support to the fleet is the reconstruction and analysis of Second Fleet Readiness Exercises, or READEXs, five of which have been conducted since the fall of 1982. These exercises have had several important features in common. First, the free-play "Hostilities" portions followed the same scenario, thereby making it easier to uncover trends in fleet performance. Second, the Orange ("Soviet") forces simulated expected Soviet tactics and equipment. Third, Orange actions that indicated hostilities were about to break out were represented by a series of realistic "indications and warnings." In many past READEXs, the focus was on the hostilities themselves rather than on the transition from peace to war – a period now considered critical by Navy planners.

The reconstruction and analysis of READEXs forms part of the Second Fleet Battle Group Evaluation program, which assesses battle group readiness and provides "lessons learned" to participants. CNA's participation in each exercise involves several steps. First, the CNA analyst at the training command in Norfolk works with the command and others involved in the exercise to identify analysis objectives. Before each exercise, CNA analysts develop a comprehensive data-collection plan that is designed to minimize the burden on participants, while still providing required data. Teams of CNA analysts from Washington and the field are placed with various elements of the battle force (Blue) and the Orange forces to make observations and collect data before reconstructing the exercise.

The reconstruction first determines the sequence of events in the exercise. It concentrates on the cause and effect of each significant interchange between Orange and Blue air, surface, and subsurface forces. Event-by-event and cumulative performance

statistics are presented for Blue forces in antiair warfare, antisubmarine warfare, antisurface warfare, strike warfare, and command, control, and communications.

The reconstruction and analysis of a READEX is completed in about ten days; results are ready to be briefed about two weeks after each exercise has ended. Results are usually briefed to the battle force commander and his staff, to participating units before they disperse, and to the various commanders who have responsibility for the training of units. Eventually, results are also briefed to the officers in charge of planning the next READEX.

In 1984, CNA supported READEX 1-84 and READEX 2-84. The Hostilities Phase of READEX 1-84, conducted at the Puerto Rican Operations Area North Range, pitted a two-carrier battle force against both Purple ("Third World") and Orange forces in a "rising tensions" scenario. The analysts' responsibilities included participation in exercise planning, data collection, exercise reconstruction and analysis, and briefing and report preparation. This exercise included an operational readiness evaluation (ORE) of one of the carriers, the USS *Saratoga* – the first ORE to be an integral part of the Hostilities Phase of an exercise.

A follow-on phase of this exercise was the ORE of the second carrier, the USS *America*. Again the scenario depicted rising tensions and included both Purple and Orange play. In this case, *America* was the only carrier involved. Another CNA team observed the ORE and participated in its reconstruction and analysis.

Several CNA field analysts helped plan and prepare for READEX 2-84. This two-carrier battle force exercise included the OREs of the carriers USS *Eisenhower* and USS *Independence*. The field representatives, working with analysts from CNA-Washington, defined analytical objectives and data-collection requirements, and designed a methodology for near real-time reconstruction of exercise events. A total of 28 analysts participated in the data collection, reconstruction, and analysis of READEX 2-84. In a related project, CNA analysts developed computer programs that speed reconstruction and improve the presentation of exercise results.

### Night Raider

At the direction of the Joint Chiefs of Staff (JCS), the military services conduct annual Special Project exercises designed to help tactical commanders develop and improve procedures for exploiting information

obtained from national sources. In FY 1984, the Navy Space Systems Division was designated the executive agent for JCS Special Project Night Raider (SPNR). The Navy, in turn, asked CNA to act as technical coordinator for the project.

SPNR consisted of six tests, carried out as part of separate exercises held in the Atlantic and Pacific Oceans. Two of the tests evaluated ways to use national sources for tactical purposes. Two others assessed new uses for intelligence-gathering capabilities. A fifth test simulated potential enemy surveillance systems to examine the effectiveness of potential measures to conceal the precise location of our naval forces. A sixth test assessed new procedures for providing intelligence to Navy and Marine forces engaged in amphibious landings.

The CNA analysts assigned to SPNR first prepared detailed plans for running the six tests, which specified the objectives of each test, measures of effectiveness, analytical methods, and data requirements. The analysts then trained the data collectors and, during the exercises, served in key positions both at sea and ashore. CNA also set up a Night Raider Coordination Center from which all aspects of the tests were managed as operations at sea unfolded. With the tests completed, CNA analyzed the results.

In one of the more complex – and exciting – of the SPNR tests, information was sent via a simulated TADIXS circuit and received in near-real time by tactical displays specially installed in the combat information center of a ship. The key point is that this information was not only received faster than once possible, but it was also displayed automatically as soon as the ship received it and made available immediately for use by the ship's fire-control system, for example.

The results of all six tests are expected to improve significantly the support provided to Navy and Marine Corps tactical commanders by national sources, and to guide decisions concerning tactical doctrine and force structure.

## FUTURE FORCES AND SYSTEMS

### New Amphibious Assault Vehicles

Amphibious assault vehicles, or AAVs, are used by the Marine Corps to bring troops ashore in an amphibious assault. In the traditional assault, AAVs are carried to within a few miles of the shore by amphibious ships, and launched at that point. They swim the remaining distance to shore, transit the surf zone, and switch to conventional track

propulsion once they are on the beach. Other components of the assault (tanks and artillery, for example) are carried to the shore by either landing craft or helicopter. In an over-the-horizon scenario, all components of the assault are carried to shore by high-speed air-cushion landing craft (LCACs) or helicopters.

The current AAV in the Marine Corps is the LVT7, which was introduced in 1972. This vehicle is approaching the end of its service life, and a service life extension program is underway. The modified vehicle, called the LVT7A1, will reach the end of its service life in the 1990s. Consequently, the Marine Corps has begun to develop a follow-on AAV – the LVT(X).

Like the LVT7, the LVT(X) will have a displacement hull; hence its waterborne performance would not be much different from the LVT7. But the LVT(X) will have a bigger gun (25-mm cannon versus a .50-caliber machine gun), a lower profile to reduce its vulnerability, and better armor protection.

To help the Marines decide whether to proceed with the next phase of LVT(X) development, the program sponsor asked CNA to undertake two related studies: an independent cost estimate and a comparison of the LVT(X) with alternative vehicles capable of performing the same mission.

Using parametric methods, CNA estimated the development cost of the LVT(X) to be about $1.1 billion (somewhat higher than the program manager's estimate), the investment cost to be about $3.2 billion, and operating and support costs to be about $6.7 billion.

CNA analysts compared the LVT(X) with the LVT7A1 and an improved LVT7A1 (the "LVT7AX"), which is representative of what could be procured in the late 1990s if the Marine Corps continued with the LVT7 family. A Marine Amphibious Force (MAF) equipped with the LVT7AX was similar in effectiveness to a MAF with the LVT(X), but the life-cycle cost of the LVT7AX was about a billion dollars less.

CNA also analyzed the effect of the LVT(X) program on the Navy's amphibious ship and LCAC programs. Both the LVT(X) and LVT7AX are somewhat heavier than the LVT7A1, which might limit the number of vehicles that could be carried on an LCAC to two instead of three. The planned LVT(X) battalion is also about one-third larger, with most of the growth due to the addition of two new vehicle variants. Thus, in an over-the-horizon scenario, the planned number of LCACs is insufficient to carry the AAVs without reduction in the rate of buildup ashore.

## A Multi-Mission Helicopter-Airplane

The Marine Corps maintains a fleet of helicopters to transport troops and equipment during assaults. Most of these helicopters are scheduled to be retired in the 1990s and must be replaced. As an alternative to a new helicopter for the Marine Corps, the Department of the Navy has been seeking an aircraft that could conduct a greater variety of operations. The Air Force and Army have been interested in such an aircraft as well.

As a result, the Navy is now leading a joint-service program to develop an aircraft that combines the vertical takeoff and landing capabilities of a helicopter with the speed, range, and fuel efficiency of a turboprop airplane. The Joint Services Advanced Vertical Lift Aircraft – or JVX – has fixed wings with engines mounted on the tips. The engines have large helicopter-like rotor blades; the engines and blades can be positioned for vertical takeoff and landing or tilted 90 degrees for horizontal flight.

In addition to the Marine Corps mission, the JVX is being designed for use in combat search and rescue by the Navy and for special operations by the Air Force. The Army plans to buy it for logistic transport. The Navy is also considering its possibilities for carrier onboard delivery, vertical replenishment, antisubmarine warfare, and airborne early warning to surface combatants.

Preliminary design work began in 1983, and a decision whether to undertake full-scale development is scheduled for 1985. To prepare for that decision, the Deputy Secretary of Defense directed that the services conduct a joint study that compares the JVX with alternative aircraft for the design missions. Both the Marine Corps and the Navy asked CNA to do the analysis for their missions.

### *Marine Corps Assault*

In wartime, assault transport aircraft may deploy aboard amphibious ships in anticipation of an amphibious assault, or if they are to marry up ashore with pre-positioned equipment, they may self-deploy or be transported by C-5 aircraft. In either case, they must be able to carry certain troops and equipment during the assault and transport them quickly, while avoiding or withstanding enemy fire.

The JVX can fly faster than any conventional helicopter, existing or new. Further, only the JVX has sufficient ferry range to self-deploy anywhere in the world; without the use of amphibious ships, helicopters would have to be lifted by the scarce C-5s to deploy rapidly. Compared with existing helicopters, the JVX can also carry troops farther and is

more survivable. However, a notional helicopter – an updated design of a helicopter previously sought by the Marine Corps – can satisfy the requirement to carry 24 troops over a radius of 200 n.mi., and incorporates all of the survivability features of the JVX. CNA's preliminary estimate is that it also costs less.

The central issue is whether the additional capabilities of the JVX outweigh its additional cost. CNA's analysis should help decision-makers to make that judgment before deciding whether to undertake full-scale development of the JVX.

*Navy Combat Search and Rescue*

CNA analysts have also been studying the Navy's combat search and rescue (CSAR) mission, comparing the JVX with the HH-60 helicopter, which the Air Force plans to procure for its CSAR mission. That helicopter has a lower speed, shorter operating radius, less avionics, and fewer survivability features than the JVX does – but it costs less.

A previous study of Navy rescues in Vietnam showed that most crewmen were downed over water, where there was little enemy opposition, and of those who survived, nearly all were rescued. On the other hand, of those downed over land (mostly in populated areas), a high percentage was captured quickly. In addition, most rescue distances were relatively short. Thus, in similar scenarios, the greater speed and range of the JVX would not result in significantly more rescues than with the HH-60.

But future scenarios might well involve less-populated areas, greater distances, or more opposition to CSAR aircraft. Preliminary, parametric analyses of such scenarios show a greater percentage of successful rescues with the JVX than with the HH-60 in most cases.

## Weapon Acquisition in the Face of Uncertainty

History shows that warfare is unpredictable. Nevertheless, the weapons of modern warfare are so complex that one must plan well in advance, in spite of the uncertainty. For example, it takes a year and more to construct most modern weapons. At least the first year of a war will therefore be fought with the ordnance on hand when the war begins.

How, then, can the Navy decide what ordnance to stock when the targets that will have to be attacked are unknown? Once the ordnance is acquired, what kinds of weapons should be stocked at supply bases in the Western Pacific or Atlantic, for example? After a given region is supplied, how should an aircraft carrier be loaded for deployment? One answer to these questions would

be to buy such vast amounts of ordnance that any situation could be dealt with. This solution is obviously infeasible, given the cost of the ordnance and storage facilities required to implement it. More precise solutions must be found.

A specific area of concern for the Navy is the problem of selecting a mix of general-purpose (GP) and special-purpose (SP) weapons. A GP weapon – for example, an unguided, "dumb" bomb that follows a simple ballistic trajectory after release – is one that can be used against a variety of targets in a variety of environments, and against many types of defenses. An SP weapon is one that can be used against only a few targets and in special environments, and that may be susceptible to defensive countermeasures, but which has a higher probability of destroying the target than the GP weapon when the requisite conditions prevail. Laser-guided and television-guided bombs are examples of SP weapons.

In sum, SP weapons are more effective under the "right" conditions, whereas GP weapons, although less effective under the same conditions, can be used in a wider variety of conditions. The mix of GP and SP weapons depends, therefor , on the degree of the decision-maker's aversion to the risk of having the "wrong" weapon if the "right" conditions do not prevail.

CNA analysts have developed a method for dealing with uncertainty in the procurement and allocation of weapons. The general concept is to compute the value of a particular mix of weapons by averaging its utility over a possible set of targets. The values for different mixes of weapons are then compared for a variety of target sets, to guard against the selection of a "best" mix on the basis of special conditions.

A second, less important, aspect of this methodology is the use of a "utility function" to evaluate a mix of weapons. Unlike the standard measure of effectiveness – the expected number of targets killed – the expected utility associated with a particular mix of weapons can reflect the decision-maker's aversion to risk. In this context, the risk is in not having a good weapon available for a particular type of target because of the uncertainty as to the mix of targets to be encountered.

An important consideration in the selection of a stock of ordnance for a region or an individual aircraft carrier is the existence of the supply network. For example, although the primary source of weapons is the carrier's own magazine, a supply ship usually travels with the carrier. More distant (in both time and space) are land-based intermediate supply depots (ISDs) and supply bases in the continental U.S. (CONUS). Supply

ships can be used to load weapons at the ISD and deliver them to a carrier task force. The ISD can then be resupplied from CONUS. Although every such resupply action involves a delay, the existence of a supply network mitigates some of the risk associated with mixes composed mainly of SP weapons – as long as the pace of operations is slow enough that the carrier does not run out of weapons.

The existence of a supply network leads, in turn, to the question of how to spread an initial allocation of weapons over CONUS and various ISDs (located in widely separated geographic areas) so as to realize the full potential of a particular mix of weapons. CNA analysts are now investigating that question.

## RACER

The oil crisis of the 1970s heightened the Navy's usual interest in making its ships more fuel-efficient. An experimental device called the Rankine Cycle Energy Recovery system – RACER for short – seemed to hold particular promise for this purpose. RACER uses steam generated by the waste heat from a ship's gas-turbine engine to spin auxiliary turbines connected to the main propulsion system.

RACER involves new and unproven technology, and the Navy wanted to test it extensively before installing it on combatants. The plan was to put it on the ninth of the new DDG-51 guided-missile destroyers, and on the following 20 ships of that class. But some members of Congress were urging the Navy to move faster and put RACER on the first eight DDG-51s also.

One issue – though certainly not the only one – was whether RACER's fuel savings would offset its costs. Earlier analyses had suggested that the net savings would be substantial, but the Navy was sceptical. It asked CNA to readdress the issue, focusing particularly on the sensitivity of the results to assumptions regarding future fuel prices, program costs, and operational factors.

CNA's analysis showed that RACER is not likely to show economic returns under any plausible circumstances. Decisions about the RACER program should therefore be based on whether the other potential advantages it offers ships – more range or endurance, less vulnerability while refueling at sea, and higher cruise speeds – are worth the extra cost, which could amount to $1.2 to $1.4 million per ship.

The results of the analysis were briefed extensively to Navy staffs and Congressional committees. The Navy is continuing its plan to put RACER on ships eventually, but with a more

realistic appreciation of the economic factors.

## The Mix of Active and Reserve Forces

Until World War II, the United States depended on the citizen-soldier to augment its small cadre of military professionals in time of war. Since then, technology and the scale of the threat to U.S. interests have forced the U.S. to develop and maintain a large, professional armed force. Yet the citizen-soldier has continued to play an important supporting role. In fact, reserve forces have received steadily more attention and resources since 1973, when conscription ended. Congress has also emphasized the need to give reserve forces new missions and more modern equipment and to integrate them more closely with active forces.

The Navy has given additional attention to reserves this past year. In spite of the constraints that long peacetime deployments by the fleet impose on the use of part-time personnel, the Naval Reserve is getting more people and newer aircraft and ships. Moreover, Navy planners are considering new roles and missions for reserves, as evidenced by the formation of a new office expressly for dealing with such issues.

CNA drew on its expertise in several areas to help the Navy address active-reserve issues. One area was reserve manpower – often a real constraint in setting up new reserve units. CNA analysts developed techniques to estimate how many skilled reservists the Navy could attract and retain in specific geographic areas, and how changes in Navy policy could increase this number. CNA also developed measures to compare the readiness of active and reserve units in peacetime, crises, and war. CNA analysts have been at work on a model to compare the costs of active and reserve units – with the controversial result that only small savings accrue from putting ships in reserve.

## The Evolving Political-Military Scene

In its long-term planning of forces and systems, the Navy tries to anticipate changes in its missions that might result from changes in other nations' missions, forces, and relationships. To help identify such changes, CNA has long conducted a program of political-military studies. The main focus of these studies has been on Soviet naval strategy and its implications for future Soviet forces and their operational use. In the past few years, CNA has broadened the scope of its political-military studies to examine the influence of allies

on the U.S.-Soviet balance of power. In particular, CNA recently analyzed France's independent nuclear force.

This study took place against the background of a French plan for significant modernization of its nuclear forces. The study examined the effects of that modernization on Soviet political and military strategy in Europe. The analysis of Soviet perceptions of French security policy sheds new light on the Soviets' reaction to NATO's decision in 1979 to modernize its intermediate-range nuclear forces (INFs).

Soviet opposition to – and French support of – the 1979 decision reveals the underlying divergence between Soviet and French political and military interests. The French view the INF deployments as a means to couple European and American defenses more firmly. The French also hope through their example to stimulate Western Europe to play a greater role in its own defense, while remaining firmly anchored in the Western Alliance. For the Soviets, such Europeanization of the Alliance is virtually a worst-case scenario, featuring a stronger Western Europe, better able to fend for itself, and a United States consequently able to operate more effectively outside Europe.

The catalyst for NATO's 1979 modernization decision was the Soviet's deployment of SS-20 missiles. That deployment strengthened the Soviets' ability to fight a conventional war in Europe. The SS-20s also served the Soviets by increasing political tensions within the Western alliance. However, NATO's answering deployment of INFs and the coincident French and British nuclear modernizations blunted the Soviets' military and political gains.

The military and political implications of France's modernization program must be understood in the context of French strategic doctrine. France faces a strategic dilemma: the conflict between, on the one hand, justification of her nuclear arsenal as being solely for the defense of French territory and, on the other hand, the emerging recognition of the need to include West Germany in France's security concept.

The latter course points to what the Soviets fear – an independent European nuclear threat, an alternative center of nuclear decision-making to the United States. Thus, although the interests of the Soviet Union may have been served in the short run by France's military break from NATO, in the long run the emergence of a significant West European nuclear force can only

complicate and make more difficult the Soviets' political and military strategy in Europe.

## MANPOWER AND MANAGEMENT POLICIES

### Manning the 600-Ship Navy

As its battle forces increase from 479 ships at the end of FY 1980 to 600 ships in FY 1989, the Navy must attract and retain more people to operate the growing fleet and the supporting shore establishment. At the same time, the population of military-age youths will continue to decline. A declining unemployment rate and growing economy will further reduce the Navy's ability to recruit new personnel and to keep experienced personnel.

The growth in the number of ships will, of course, mean more sea duty, further complicating the Navy's problems. Trying to man more ships by raising the percentage of time sailors spend at sea is counter-productive: It causes reenlistments to fall off. The alternative of raising the total number of enlisted personnel to create a bigger pool to rotate between sea and shore cannot be counted on. Every year, Congress sets a limit on endstrength – the number of active-duty personnel each service can maintain. Historically, Congress gives the services lower endstrengths than they request.

Yet another way to attack the problem is to reduce in strength those occupations that serve primarily on shore. The billets that are freed can then be reassigned to sea-intensive occupations. CNA developed a method to help Navy manpower managers determine which occupations could be reduced in strength. Seventy-one occupations were rated for such factors as replacement cost, retention cost, the percentage of time spent at sea, and whether the occupation is critical to the peacetime mission. Factor analysis then produced a rank ordering that indicates the effect on the fleet's readiness of reducing a billet in each occupation. The occupations with the lowest scores are candidates for reduction; the billets released from those occupations can go to occupations with the highest scores – the mission-critical, sea-intensive occupations. The duties performed by the billets that are reallocated could be taken over by civilians, reservists, or both.

Another aspect of the Navy's manning problem is the question of balance between first-term and experienced personnel. Earlier CNA studies have shown that taking in fewer people and retaining them longer (creating a career force) would be an efficient way of meeting endstrength goals, and would improve the fleet's readiness. In 1984, CNA

analysts focused not just on ways to increase retention, but on ways to retain the highest quality personnel. Such personnel are of particular concern because retention is related negatively to mental ability. More specifically, at the first reenlistment point, the Navy is most likely to lose its smartest, most productive people.

What can the Navy do to get these people to stay in? Obviously, when military pay is raised, more personnel reenlist. Moreover, CNA found that increases in regular pay or in selective reenlistment bonuses not only induce more reenlistments, but do so disproportionately for the best people. Conversely, if Navy pay lags behind civilian pay, the resulting manpower shortages will be concentrated among the best people. Pay increases therefore not only increase retention, but also increase the quality of the career force.

CNA's manpower analysts also found that the Navy has yet another tool it can use to retain more of its most productive personnel – promotion. For the amount of pay involved, promotion yields large returns in retention. In addition, promotion is a well-targeted policy: The Navy promotes those people who are most valuable to it. Therefore, a policy of faster advancement in undermanned ratings can significantly improve the retention of personnel who are most productive and in the shortest supply.

## Alcohol and Drug Use in the Marine Corps

In 1980, according to a Department of Defense study, 47 percent of enlisted Marines in the five lowest grades (E1 to E5) were using drugs and 19 percent of them were heavy drinkers. In 1982, a second study reported that 25 percent used drugs and 12 percent were heavy drinkers. By 1983, drug use was down to 20 percent; heavy drinking, to 8 percent.

This sharp drop in drug and alcohol use is one of the major findings of a CNA study based on a survey of 18,000 Marines at 21 major commands in four geographic areas. The study was conducted at the request of the Marine Corps to assess the effectiveness of programs aimed at reducing drug and alcohol abuse in the Corps.

The survey used to measure the extent of drinking and drug use was designed and administered by the study team. Under the auspices of Headquarters, Marine Corps, CNA analysts administered the survey in the summer of 1983. Participants were chosen at random from among Marines ranging in rank from private to colonel.

Results of the study showed that 85 percent of Marines drank some type of alcoholic beverage. In terms of beer consumption, about half drank one or

two beers a day; 8 percent were heavy drinkers, consuming more than seven beers a day. Heavy drinking was most prevalent among Marines in Divisions and among those stationed on Hawaii. Most heavy drinkers were E1s to E5s, 25-years old or younger, unmarried, male, and non-high school graduates.

More than half of the Marines surveyed had never used drugs; 35 percent of the respondents said they had been using drugs just before they joined the Marine Corps. Two-thirds of these prior users said that they quit upon enlistment, and many others quit soon after. Only 9 percent of the respondents began to use drugs after enlistment.

About 20 percent of Marines used drugs for nonmedical reasons during the summer of 1983; 90 percent of the users smoked marijuana and 6 percent used such "hard" drugs as cocaine and PCP. About two-thirds of hard-drug users also used marijuana.

Among major commands, a greater proportion of Division personnel used drugs. Drug users tend to share many of the same characteristics as heavy drinkers; that is, they are younger, unmarried, male, in the lower pay grades, and non-high school graduates.

Drug use and drinking are related. More than half of the heavy drinkers used marijuana while drinking.

Results of the CNA study, the third in four years, were encouraging. Between 1980 and 1983, drinking and drug use in the Marine Corps had fallen considerably. Although the total number of drinkers remained fairly constant, the percentage of heavy drinkers dropped drastically. In other words, many heavy drinkers became moderate and light drinkers. Equally dramatic was the reduced usage of drugs. The percentage of junior personnel who used marijuana and other illegal drugs fell by more than half between 1980 and 1983. (Almost no senior personnel used drugs.)

In addition to measuring the prevalence of alcohol and drug use, the study team evaluated drug and alcohol programs. The drop in drug use and the shift toward more moderate drinking reflects the effects of the Marine Corps program of education, identification, and rehabilitation.

The survey found that 45 percent participated in Marine Corps-sponsored education programs. Those who participated reported that their use of drugs and alcohol had

decreased. Talks by commanding officers and senior enlisted personnel and "rap" sessions have been particularly effective. These and other programs help to increase awareness of the consequences of heavy drinking and drug use, and awareness apparently leads to reduced use.

Urinalysis is the primary means of identifying drug users, and fear of detection by urinalysis has been the major deterrent of drug use. However, of all Marines tested in 1983, a third were first tested with field kits. Positive results from such tests must be confirmed by more sophisticated laboratory tests. As a result, it was found that the laboratory did not confirm a third of the positive samples collected in the field. One effect of such discrepancies was reflected in the survey results. Only 25 percent of E1s to E5s trusted the results of urinalysis.

It was found later that one type of field equipment – semi-automated units operated at major commands – had been calibrated to "flag" samples with lower concentrations of drugs than would be flagged by lab equipment. Field test procedures have since been changed to be more compatible with laboratory standards.

In general, the Marines' efforts to rehabilitate heavy users of drugs and alcohol have worked well. More than half of those who participated in rehabilitation programs stopped using drugs or alcohol. This is a much higher success rate than is typical for civilian programs.

## Contract Support Services

When projects require special skills or knowledge that are not readily available in the government, the Navy and other parts of the Department of Defense often turn to outside specialists for help. The services these outsiders provide – consultation, studies, administrative support, or technical assistance – are called Contract Support Services, or CSS for short. Big sums are involved: The Navy spends from several hundred million to several billion dollars annually on CSS, depending on the way the funds are accounted for.

Chronic problems have hindered efforts over the years to manage CSS effectively and to ensure that the government gets its money's worth. Accounting has been unreliable; policy directives have gaps and contradictions; budget presentations have been uninformative. Even many of the terms used in referring to CSS matters have not been defined consistently or precisely.

The slow progress toward solving these problems has drawn increasing fire in recent years from the Congress

and senior defense officials, uniformed and civilian. The dissatisfaction in Congress has resulted in budget cuts, the latest one being of major magnitude.

In September 1983, the Navy asked CNA to diagnose the problems afflicting its CSS processes and to propose solutions. By the spring of 1984, the study team had accomplished the first part of this task. During the spring and fall, the team (now augmented by people from the Naval Material Command, where most CSS funds are spent) developed a set of proposals calling for (1) fewer, simpler, and more precise definitions of terms, (2) the integration of policy and procedural guidance, (3) the use of the Navy's regular accounting system to record CSS obligations, rather than the Federal Procurement Data System, and (4) a more informative format for budget presentations that takes advantage of accounting reforms and permits rapid and accurate reconciliation between budget data and results.

The findings were briefed to senior Navy officials, who asked CNA and the Naval Material Command to refine and test the proposals and to develop plans for implementing them. The analysis is also expected to influence the work of two other groups concerned with CSS reform on a broader scale: the Office of Management and Budget, and a CSS Action Group in the Office of the Secretary of Defense.

# III. The 1985 program

## OBJECTIVES AND PROCEDURES

In the fall of 1983, a team of Hudson officials and distinguished experts in naval matters evaluated CNA's management and operations and submitted its report to the Navy's Policy Council for CNA. Among the team's recommendations were to:

- Give greater attention to the most pressing issues faced by top-level decision-makers
- Assure that CNA-Washington projects reflect the "real-world" experience gained in the field
- Increase support for CNA's field program
- Increase analytical support for the Fleet Commanders-in-Chief
- Develop and maintain the expertise needed to address issues effectively.

The research program that is outlined in this section is aimed at these goals. To ensure the relevance of CNA's research to the analytical needs of the Navy and Marine Corps, CNA has adopted new procedures for program planning.

The program is revised quarterly, rather than annually as in the past. Based on an internal review of progress, suggestions from the CNA staff, and requests from the Navy and Marine Corps, CNA management develops a program that indicates continuing projects and new starts during the next 12 months. The program features a specific allocation of available analytical resources in the coming quarter.

After review and approval by the Executive Committee of the CNA Board of Overseers, the program is submitted to the Vice Chief of Naval Operations and Assistant Commandant of the Marine Corps. Through their staffs, the proposed program is reviewed and an agreed program is arrived at for presentation to the Department of the Navy's Policy Council for CNA.

In addition to this quarterly process, CNA continues to respond to requests for ad-hoc projects when the issues are important enough and when CNA has

the expertise to do a good job. Moreover, the quarterly program includes explicit allowances for ad-hoc work of various types: quick-response analyses and scientific analyst support for Washington offices of the Navy and Marine Corps, plus Washington augmentation of field representatives.

## SUMMARY OF FY 1985 RESEARCH PLANS

### Allocation of Effort

This is the allocation of analytical effort that CNA, the Navy, and the Marine Corps agreed to for the first quarter of FY 1985:

| | Equivalent Full Time Analysts | | |
|---|---|---|---|
| Type of Activity | Navy Projects | USMC Projects | Total |
| Support of Washington Offices | | | |
| Long-term projects | 75 | 15 | |
| Quick-response analyses | 10 | 2 | |
| Scientific analysts | 3 | 2 | |
| | 88 | 19 | 107 |
| Support for the Fleets and Fleet Marine Forces | | | |
| Washington based projects | 11 | – | |
| Field representatives | 34 | 4 | |
| Washington augmentees | 6 | 1 | |
| | 51 | 5 | 56 |
| Methodology Development | 11 | 1 | 12 |
| | 150 | 25 | 175 |

### Support of Offices in Washington

This support includes long-term projects, quick-response analyses, and the efforts of scientific analysts. Long-term projects last from several months to one or more years. Some provide direct analytical inputs to the Navy's planning, programming, and budgeting process. Others deal with particular issues. Both often lead to the development of expertise

needed for quick-response analyses. Among the new long-term efforts planned for FY 1985 are:

- A major increase in the size and scope of CNA's electronic warfare project
- Significant growth in systems design and technology work
- A broadly based program of Soviet military studies.

Long-term efforts for the Marine Corps will include several new manpower studies and assessments of requirements for combat service support and air defense.

The second type of support CNA provides to offices in Washington is quick-response analysis. Projects of this type take from a few days to a few months and usually deal with some of the Navy's most important issues. Among the several important quick-response efforts underway as FY 1985 began were an analysis of industrial mobilization capacity, an investiga tion of Naval aircraft accident rates, and analyses of Marine Corps fitness reports. Such projects afford opportunities for CNA to apply its expertise to urgent issues, and to expand the scope of its efforts for the Navy and Marine Corps.

The third type of support is the scientific analyst program. Since the late 1940s, CNA has assigned analysts to some divisions within the office of the Chief of Naval Operations and Headquarters, Marine Corps, on a part-time basis, to conduct quick-response analyses for the offices to which they are assigned, to maintain liaison between CNA and those offices, and to help the staffs formulate larger studies for CNA to undertake when appropriate.

### Support to the Fleets and Fleet Marine Forces

At the beginning of FY 1985, major revisions were made to the Navy portion of the CNA field program. The most significant change was the establishment of two four-man tactical analysis teams in Norfolk and San Diego. The teams will provide support to battle groups during their work-up periods and will support fleet exercises and tests. On occasion, analysts will deploy with some battle groups for such specific objectives as testing specially configured air wings and evaluating major new systems at fleet introduction. The teams will be able to document tactical innovations and operations at the battle-group and battle-force levels, with augmen tation from CNA-Washington.

A new billet has been established at the Naval Strike Warfare Center, to support the development and evaluation of strike warfare tactics.

To strengthen its support to the Fleet Commanders-in-Chief, CNA has reopened the billet at the headquarters of the Atlantic Fleet. CNA will continue to expand its Washington-based assessments of capabilities for the Commanders-in-Chief of the Atlantic Fleet, Pacific Fleet, and U.S. Naval Forces, Europe. Fleet support is oriented toward the development of concepts of operations, studies of strategic issues, and logistics analyses. CNA will continue to augment its field representatives with analysts from Washington during major fleet exercises.

CNA's field activities at Marine Corps commands have been expanded by the assignment of a second analyst to Marine Aviation Weapons and Tactics Squadron One, to help the command implement its new tactical development and evaluation program. In addition, CNA plans to provide analytical support during the coming year for the evaluation of combined arms exercises at the Marine Corps Air Ground Combat Center.

### Development of Methodology and Other CNA-Initiated Research

During the coming year, CNA will devote more resources to the development of analytical models, which are the tools for many studies in the field and in Washington, and to the maintenance of data bases needed for sound modeling – over and above any such work that is done as part of projects in direct support of the Navy and Marine Corps.

Development of models and data bases used by CNA is greatly supported by CNA's work in the field. Current projects that draw on field data and experience include the improvement of exercise analysis methods, improvement of models of air-to-air and air-to-surface weaponeering, development of a model of the process for identifying submarine contacts, and development of models of antisubmarine warfare in the Arctic.

## SPECIAL PROGRAMS

Some new activities were undertaken in FY 1984, and will gather momentum in FY 1985: conferences, talks by guest speakers, and a fellows program. These activities are designed to serve both the Department of the Navy and CNA by encouraging the exchange of ideas among analysts, technical experts, and policy-makers.

### Conference Series

Every fall, CNA will hold a major, two-day symposium on the vital issues of sea power that face the United States and the Western alliance. Such matters as technological trends, force design, missions, and strategies will be analyzed and debated. In addition

to papers and commentaries by knowledgeable analysts, there will be major addresses by senior Navy officials. The focus of the annual symposium – called the Sea Power Forum – will rotate among these four main subjects:

- The U.S. Navy
- The U.S. Marine Corps
- Soviet and Other Communist Navies
- Allied and Third-World Navies.

Every four years, therefore, a host of major issues and most of the world's navies will be analyzed and assessed. The papers, commentaries, and addresses of each symposium will be made available to a wider audience through books.

### Guest Speakers

A noon speakers program will be open to all CNA employees. It will feature remarks by, and off-the-record discussions with, distinguished guests drawn mainly from the Washington area.

### Fellows Program

This program is expected to add to the stock of knowledge and skills that CNA brings to bear on the problems facing the Navy and Marine Corps. It comprises Distinguished Fellows, Senior Fellows, Visiting Fellows, and Adjunct Fellows. Through these fellowships, CNA will have access to talent and experience that might not otherwise be available.

# IV. Organization

## CNA'S MATRIX STRUCTURE

CNA is organized in a matrix of "divisions" and "research departments," as shown in the chart on the next page. Through the line divisions, CNA responds to the specific analytical needs of the Navy and Marine Corps – in the field and in Washington. The research departments foster the development and maintenance of expertise and its proper application to the needs of CNA's clients. Each member of the research staff belongs to one of the research departments; assignments to projects depend on clients' needs and staff members' qualifications. The following sections describe the specialties of these research units.

## LINE DIVISIONS

With the exception of the Field Operations Division, through which analysts are assigned to Navy and Marine Corps commands worldwide, the divisions are organized into programs.

### Naval Warfare Operations

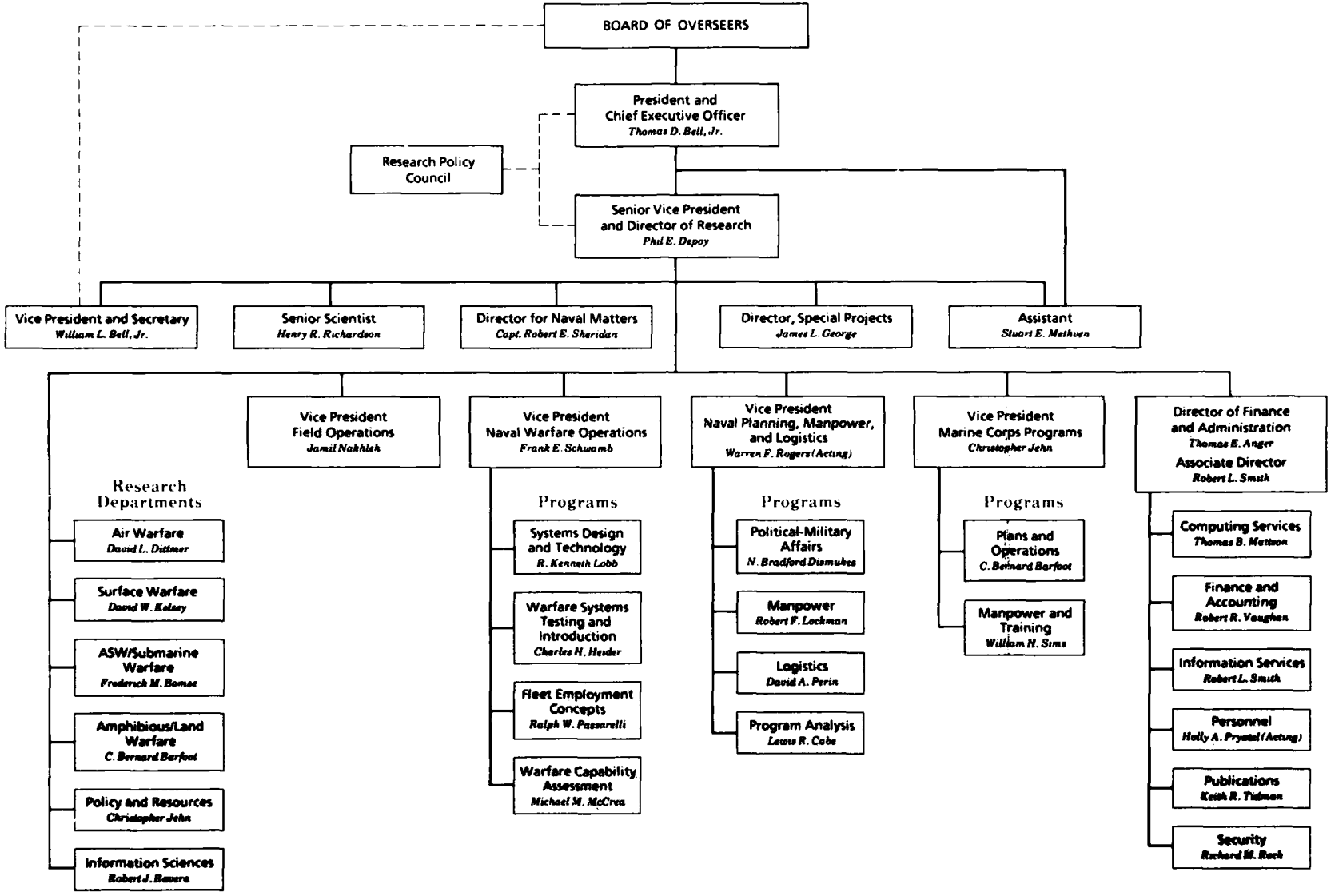
Analysts in ***Systems Design and Technology*** help to shape and evaluate new concepts for ships, aircraft, weapon systems, sensors, and communication-information systems. They also help to structure effective research, development, and evaluation programs for such clients as the Navy's Director of Research, Development, Test, and Evaluation.

Analysts in ***Warfare Systems Testing and Introduction*** aid in the operational testing and evaluation of weapon systems, sensors, ships, and aircraft and their introduction into the fleet. They work with the Commander, Operational Test and Evaluation Force, the numbered fleets, and the Office of the Chief of Naval Operations.

For these same clients, ***Fleet Employment Concepts*** develops and helps to test concepts for integrated operations by forces in various naval missions and areas. This program serves as CNA's focal point for wargaming, a tool used increasingly by clients in the Navy to investigate the merits of different concepts of operation.

***Warfare Capability Assessment*** analyzes fleet exercises and operations to assess the capabilities and estimate the future performance of battle forces and weapon systems. Much of this work is used by the Director of Naval Warfare, the

# ORGANIZATION OF CNA



program's primary client, in the preparation of his annual appraisals of Naval warfighting capability.

### Naval Planning, Manpower, and Logistics

The ***Manpower*** program develops and assesses ways to enhance the personnel readiness of the fleet. The program's studies help the Navy to determine its personnel requirements, to forecast the supply of personnel, and to shape the policies that will put the two in balance. Clients include the Deputy Chief of Naval Operations (Manpower, Personnel and Training), Director of Naval Reserve, and Director of Navy Program Planning.

The focus of the ***Logistics*** program is on finding ways to improve logistics support to the fleet, in wartime and peacetime. Analysts also perform studies on upgrading the material condition of the fleet. Clients include the Deputy Chief of Naval Operations (Logistics) and Director of Navy Program Planning.

Major developments in international politics, economics, and military affairs are analyzed in ***Political-Military Affairs.*** The emphasis is on helping fleet commanders and Navy leaders in Washington anticipate new mission requirements. The primary client is the Deputy Chief of Naval Operations (Plans, Policy and Operations).

Areas of emphasis in ***Program Analysis*** include issues in resource analysis and program planning that cut across the responsibilities of many Navy officials. The program also conducts analyses to improve the methods and processes used in Navy resource planning and management. The primary client is the Director of Navy Program Planning.

### Marine Corps Programs

***Plans and Operations*** conducts planning studies for Headquarters, Marine Corps, and the Marine Corps Development Center. The planning studies deal mainly with the costs and effectiveness of alternative future systems for amphibious assault, ground combat, tactical aviation, antiair warfare, logistic support, intelligence, and command, control, and communications.

Working mainly with the Manpower and Training Departments of Head quarters, Marine Corps, analysts in ***Manpower and Training*** address all aspects of manpower policy and personnel administration: accession criteria, recruiting, testing, training standards and methods, personnel assignment, performance evaluation, compensation, and retention. In

addition, this program provides technical advice and analytical support to the Corps on joint-service manpower and training issues.

These programs and the CNA field representatives assigned to Marine Corps commands (see the next section) together form the ***Marine Corps Operations Analysis Group***.

## Field Operations

CNA's field program is unique in the defense-analysis community. Analysts are assigned to the twenty-eight Navy and Marine Corps commands and two CNA Tactical Analysis Teams shown in the map and list on page 40. The analysts at Navy commands together form the

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### MANAGEMENT RESPONSIBILITIES

Under the guidance of the ***Board of Overseers,*** the ***President*** is responsible for the successful execution of CNA's research mission and supporting functions. He works with the Navy's CNA Policy Council and other senior Department of the Navy officials to see that CNA's research program is aimed at significant issues. The President also attends to CNA's relations with the broader defense community in the Executive Branch and Congress. The ***Senior Vice President and Director of Research*** is responsible for the planning and execution of the research program, and for maintaining the overall quality of CNA's work. Policies with regard to client relations, types of research, and research priorities are developed by the President and Senior Vice President in consultation with the ***Research Policy Council,*** which also includes the other Vice Presidents, the Research Department Directors, and the Director for Naval Matters.

***Division Vice Presidents*** plan and oversee most of CNA's defense research. They maintain close contact with Navy and Marine Corps officials, help to determine what work CNA should undertake, set the parameters and goals for each study, and see that key decision makers are apprised of progress and results. Working under them, ***Program Directors*** are responsible for the planning and execution of projects in their respective areas. They, too, maintain close contact with their clients to see that research is aimed at the right problems. Within the programs, ***Project Directors*** plan projects in detail, assign tasks, monitor progress closely, and see that research stays on target, through frequent consultation with their immediate clients. Project Directors also take the lead in preparing briefings and documenting results.

***Research Department Directors*** have primary responsibility for the administration and development of CNA's research staff. They participate in the hiring and training of new staff members and in the assignment of personnel to research projects in the divisions. Research Department Directors are also responsible for ensuring the development and maintenance of CNA's analytical expertise. Specifically, Research Department Directors lead research aimed at building and improving models and data bases, and occasionally direct major CNA studies. They also organize courses and seminars, and sponsor such career enhancing activities as the preparation of papers for professional meetings.

The ***Director for Naval Matters (DNM),*** a senior Navy captain, is assigned to the Center with the concurrence of the President of CNA. The DNM has administrative responsibility for the Operations Study Group (see below), and maintains liaison with the Bureau of Naval Personnel to keep the Operations Study Group staffed with qualified personnel. He also conducts special analyses within CNA, as directed by the Senior Vice President.

The ***Operations Study Group (OSG)*** comprises the 18 Naval officers and 2 enlisted personnel assigned to CNA as working members of the analytical and support staffs. They are selected on the basis of military experience and performance, as well as academic background (14 of the officers hold advanced degrees). Aside from their valuable analytical contributions, the members of OSG provide the rest of CNA's research staff with practical experience, technical knowledge, and a user's point of view.

The ***Vice President and Secretary to the Board*** sees that the regular meetings of the Board of Overseers provide adequate and accurate information about CNA's research and business activities. He also keeps the Board abreast of important developments throughout the year.

Operations Evaluation Group (OEG), which has helped the Navy in the assessment of operations and development of tactics since World War II. Analysts assigned to work in the Navy's Tactical Development and Evaluation Program are further designated as Tactical Analysis Group (TAG) analysts.

Field representatives spend long enough at their assignments – normally two years – to know the forces and systems they are analyzing, but not so long that they lose their detached point of view. Returning field representatives apply their invaluable experience to projects for Navy and Marine Corps offices in Washington. Analysts in the field regularly request and get support from Washington-based analysts. This assistance often takes the form of sending Washington-based analysts to help the field representatives plan, observe, and analyze large-scale exercises and tests.

The main emphasis in the division remains what it was when CNA's forerunner, the Anti-Submarine Warfare Operations Research Group, was formed in 1942 – getting the most out of the forces at hand by sending scientists to work with the forces. Today, the work of CNA's field representatives falls into three main categories: evaluation of system performance, tactical development and evaluation, and assessment of fleet effectiveness.

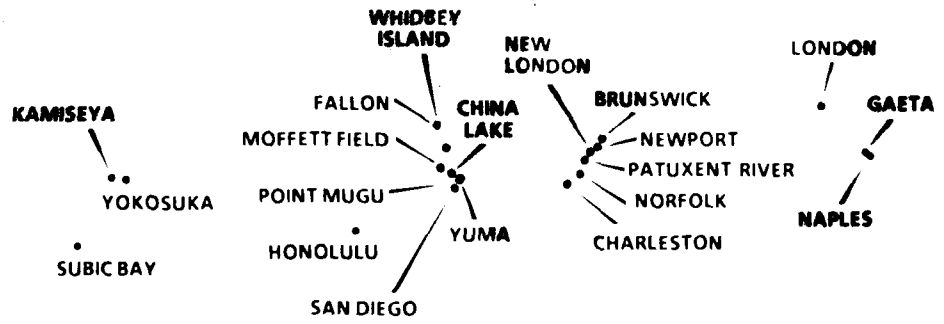
System performance is evaluated both before and after systems reach the fleet, and the evaluations help the Navy and Marine Corps decide whether to accept new systems and how to modify them to make them more effective. The combat effectiveness of forces also depends critically on sound tactical doctrine; about half the field representatives contribute directly to the development and evaluation of tactics for Navy and Marine Corps forces. Field representatives also help fleet commanders to assess the effectiveness of forces through the planning, reconstruction, and analysis of major fleet exercises. Analyses of individual exercises point the way to specific improvements in training and operational procedures; summaries of many exercises help to form realistic estimates of force effectiveness.

## RESEARCH DEPARTMENTS

A matrix organization differs from the traditional line organization by assigning separate responsibility for the management of key resources – in CNA's case, the research staff.

As indicated earlier, the research departments enhance the quality of CNA's efforts for its clients by

# LOCATIONS OF FIELD REPRESENTATIVES




**BRUNSWICK, MAINE**
Patrol Wings, Atlantic

**CHARLESTON, SOUTH CAROLINA**
Cruiser-Destroyer Group Two

**CHINA LAKE, CALIFORNIA**
Air Test and Evaluation Squadron Five

**FALLON, NEVADA**
Naval Strike Warfare Center

**GAETA, ITALY**
Sixth Fleet

**HONOLULU, HAWAII**
Commander-in-Chief, Pacific Fleet
Fleet Marine Force, Pacific
Third Fleet

**KAMISEYA, JAPAN**
Patrol and Reconnaissance Force, Pacific Fleet

**LONDON, ENGLAND**
Commander-in-Chief, U.S. Naval Forces, Europe

**MOFFETT FIELD, CALIFORNIA**
Patrol Wings, Pacific

**NAPLES, ITALY**
Battle Force, Sixth Fleet
Submarine Force, Sixth Fleet
Maritime Surveillance and Reconnaissance Force, Sixth Fleet

**NEW LONDON, CONNECTICUT**
Submarine Development Squadron Twelve

**NEWPORT, RHODE ISLAND**
Naval War College

**NORFOLK, VIRGINIA**
Commander-in-Chief, Atlantic Fleet
Fleet Marine Force, Atlantic
Second Fleet
Tactical Training Group, Atlantic
Operational Test and Evaluation Force
CNA Tactical Analysis Team

**PATUXENT RIVER, MARYLAND**
Air Test and Evaluation Squadron One

**POINT MUGU, CALIFORNIA**
Air Test and Evaluation Squadron Four

**SAN DIEGO, CALIFORNIA**
Fighter Airborne Early Warning Wing, Pacific
Tactical Training Group, Pacific
CNA Tactical Analysis Team

**SUBIC BAY, PHILIPPINES**
Carrier Striking Force, Seventh Fleet

**WHIDBEY ISLAND, WASHINGTON**
Medium Attack Tactical Electronic Warfare Wing, Pacific

**YOKOSUKA, JAPAN**
Seventh Fleet

**YUMA, ARIZONA**
Marine Aviation Weapons and Tactics Squadron

building and maintaining expertise. The departments do this in three main ways: by conducting research that is aimed at developing models and data bases, by organizing courses and seminars for analysts, and by supporting analysts' participation in outside professional activities. These are the departments' areas of concentration:

- ***Air Warfare*** provides expertise in all aspects of Navy and Marine Corps tactical aviation.
- ***Submarine and Antisubmarine Warfare*** comprises specialists in surface, air, and submarine ASW, and in submarine and mine warfare.
- ***Surface Warfare*** specializes in Naval surface forces, systems, and operations other than those involved in tactical aviation and ASW.
- Analysts in ***Amphibious and Land Warfare*** specialize in the forces, operations, and systems of Marine Air-Ground Task Forces and Amphibious Task Forces.
- ***Policy and Resources*** fosters such non-warfare disciplines as political science, economics, cost analysis, logistics, and management science.
- ***Information Sciences*** builds and maintains expertise in the technologies, systems, processes, and analytical techniques that bear on the role of information in combat, combat support, and management.

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**RESEARCH-SUPPORT ACTIVITIES**

The ***Director of Finance and Administration*** is responsible for all matters relating to financial and contractual management, for programs affecting physical security, for compliance with the Industrial Security Regulations of the Defense Investigative Service, for publication and distribution of research reports, and for CNA's computational facilities. These activities are organized into six departments:

***Computing Services*** is responsible for operation of the computer center, for centralized programming, and for a proper match between the capabilities of computing resources and the needs of CNA users.

***Finance and Accounting*** provides cost and management accounting reports, financial mangement services, contract administration, and procurement services.

***Information Services*** acquires, disseminates, and controls research materials. This department is also responsible for managing CNA's classified and unclassified libraries, and for developing and maintaining on-line access to sources, through CNA's computer.

***Personnel*** provides recruiting, interviewing, and testing services; maintains personnel records; administers the salary and fringe benefits programs; and manages CNA's Equal Employment Opportunity and Affirmative Action programs.

***Publications*** comprises the editorial staff and production center. It provides editorial, composition, graphic arts, and reproduction services to all components of CNA, and prepares special publications.

***Security*** assures compliance with the Industrial Security Regulations of the Defense Investigative Service and is responsible for providing building maintenance and office service support

# V. Resources

## FUNDING

The tables and chart on the next pages depict CNA's finances for FY 1984. Of CNA's total funding for the year – $20.5 million – 96 percent came from the Department of the Navy, 2 percent from other Department of Defense sources, and 2 percent from non-defense agencies of the government. This distribution is in keeping with CNA's main role as the Department of the Navy's Federal Contract Research Center for studies and analyses.

## PERSONNEL

### Size of the Staff

At the end of FY 1984, CNA employed 383 full-time and part-time personnel. The full-time staff of research managers and professionals numbered 168. Their efforts for the Navy and Marine Corps were made possible by the contributions of the executive managers, technical aids, administrators, and support staff members who round out the CNA family.

### Qualifications of the Research Staff

To conduct its challenging program of research for the Navy and Marine Corps, CNA hires specialists with experience in defense matters, as well as qualified persons with little or no background in defense, but who have outstanding achievements in other fields or strong academic credentials.

#### FINANCES

CNA functions as a division of the Hudson Institute, a not-for-profit research organization. All of CNA's contracts, bank accounts, and other legal agreements are executed by designated officials of the Hudson Institute and are carried in Hudson's name. On all contracts with the Department of the Navy (DON), the Institute charges a 2 percent fee, which is applied to long-range studies of interest to the Navy.

#### CASH REQUIREMENTS

Because CNA lacks other sources of capital, the DON provides working capital through an advance funding account. Advances are drawn twice a month on the basis of anticipated expenditures and are offset by monthly vouchers. All contract expenditures are reviewed by CNA's accounting staff, to ensure compliance with federal regulations and contract provisions.

#### FINANCIAL CONTROL

Financial control is achieved through a system of budgeting and expense monitoring. Expenditures for travel, supplies, equipment, and consultants are documented by requisitions and approved by CNA's management. Major purchases must be approved in advance by the Navy's Administrative Contracting Officer. The Defense Contract Audit Agency and Hudson's public accountant regularly audit CNA.

## STATEMENT OF COMPARATIVE FINANCIAL CONDITION

30 September 1984 and 30 September 1983

### ASSETS

| | 1984 | 1983 |
|---|---|---|
| Current Assets | | |
| Cash | $ 698,163 | $ 801,458 |
| Receivables (note 1) | 1,695,495 | 255,299 |
| Travel advances and prepaid items | 114,477 | 83,580 |
| Net capital account (note 2) | 1,037,847 | 138,186 |
| Total current assets | $3,545,982 | $1,278,523 |

### LIABILITIES AND RESERVE FOR DISALLOWANCES

| | | |
|---|---|---|
| Current Liabilities | | |
| Advances – U.S. Navy | $2,211,685 | $ 16,646 |
| Accounts payable | 237,223 | 465,992 |
| Payroll taxes and other withholdings | 21,075 | 7,437 |
| Total current liabilities | 2,469,983 | 490,075 |
| Other Liabilities | | |
| Accrued annual leave | 946,745 | 788,448 |
| Miscellaneous | 122,630 | – |
| Total other liabilities | 1,069,375 | 788,488 |
| Reserve for disallowances | 6,624 | – |
| Total liabilities | $3,545,982 | $1,278,523 |

**NOTES:**

1. Government agencies account for over 95 percent of all receivables.

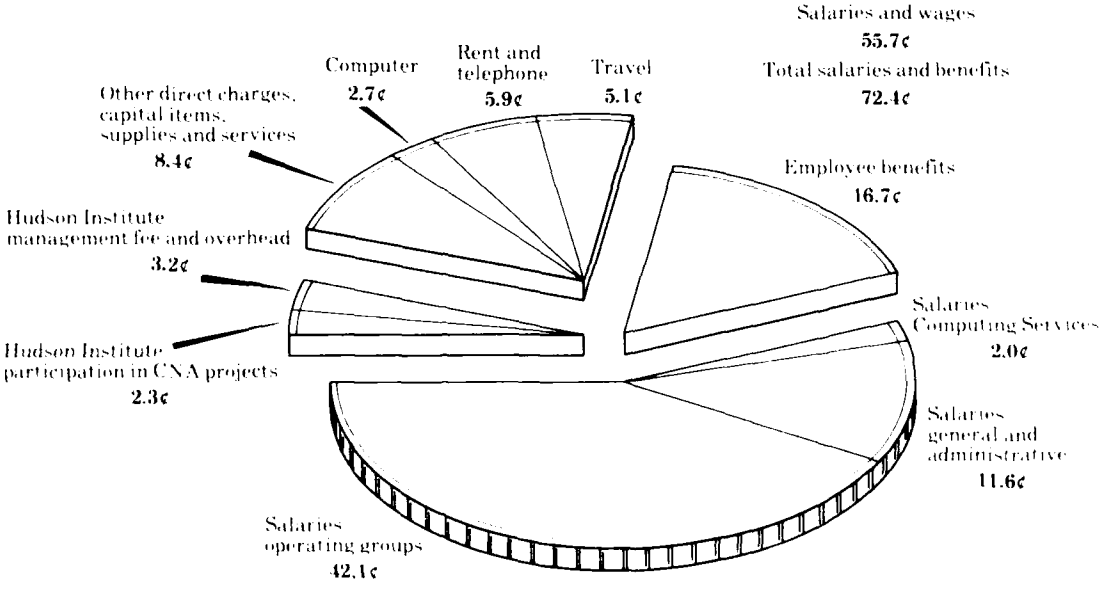
2. CNA has no physical assets. Property and equipment constitute direct charges, with title vesting in the government. Increase in capital account reflects the unamortized balance of CNA's VAX 11/780 computer system, an equipment purchase funded through an increase in CNA's advance funding agreement with the Navy.

## FUNDING IN FY 1984
(Thousands of Dollars)

| | | | |
|---|---|---|---|
| **Source of Funds:** | Defense: | | |
| | Department of the Navy | $19,840 | |
| | Other DOD sources | 346 | |
| | Total defense funding | | $20,186 |
| | Non-defense funding: | | 356 |
| | Total FY 1984 funding | | $20,542 |
| | Funds carried forward from FY 1983: | | |
| | Defense | | 2,013 |
| | Non-defense | | 235 |
| | Total funds available in FY 1984 | | $22,790 |
| **Application of Funds:** | CNA program costs (note 1) | | $22,046 |
| | Hudson Institute research and management fees | | 744 |
| | Total funds applied | | $22,790 |

1. Includes $475,000 available for Hudson Institute's participation in CNA projects.

## APPLICATION OF FUNDS IN FY 1984



## POSTGRADUATE DEGREES
(Proportion of Research Staff, 1984)

| | Doctor's | Master's | Total |
|---|---|---|---|
| Center for Naval Analyses | 65% | 26% | 91% |
| 18 Contract Research Centers | 29 | 33 | 62 |
| 25 Federal Research Laboratories | 16 | 16 | 32 |
| 43 Profit-seeking firms | 18 | 25 | 43 |

The tables above and below show the source of recent hires to CNA's research staff, and compare the academic attainments of CNA's research staff to those of similar research organizations.

### RESEARCH STAFF RECRUITING
(1979-1984)

| Source of hires | Percent |
|---|---|
| University (student) | 39 |
| Private industry | 23 |
| University (faculty or staff) | 18 |
| Federal government | 6 |
| Non-profit organization | 10 |
| Military | 4 |
| Total | 100 |

The large percentage of research staff members with advanced degrees gives CNA an important asset in conducting detailed, thorough research. The diverse nature of CNA's research program requires a mix of academic disciplines, as shown in this table:

| | Percentage of research staff |
|---|---|
| Physics and chemistry | 30 |
| Mathematics and statistics | 20 |
| Economics, business, and finance | 17 |
| Engineering | 11 |
| Operations research | 8 |
| Psychology and sociology | 3 |
| Political science and international relations | 3 |
| History | 2 |
| Other | 6 |
| Total | 100 |

CNA takes pride in the practical experience of its staff. More than 40 percent of CNA's research staff has spent one or more tours in field assignments at Navy and Marine Corps commands, where they have acquired first-hand knowledge of the forces, systems, and operations they are called upon to analyze at CNA-Washington. Researchers with field

experience have spent, on average, more than 3 years in the field. More generally, the research staff's professional work experience averages 14 years, with 10 years of that in defense research. The staff's experience, combined with post-graduate education that averages almost 5 years, sets CNA apart from most organizations in the credentials that its staff brings to bear on significant national-defense issues.

### Training

CNA does not rely on experience alone to develop an expert staff. In FY 1984, CNA expanded and improved its orientation and training program for new research staff members. Through group discussions and one-on-one sessions with senior analysts, new staff members learn about the organization, forces, and systems of the Navy and Marine Corps, about the defense decision-making process, and about which analytical techniques are applicable to specific types of problems. This process usually spans two years at CNA headquarters in Washington, and includes at least one temporary assignment in the field. The research department to which a new analyst is assigned also provides training through seminars and projects designed to acquaint the analyst with the problems and techniques in his area of specialization.

## RESEARCH AND SUPPORT FACILITIES

To support them in their research, CNA provides the research staff with a variety of facilities and services. This section focuses on those resources that are used directly in the preparation and production of research reports.

### Information Resources

One of the most valuable research tools available to analysts at CNA is the extensive collection of data, models, and analytical and technical reports that has been built up since 1942. A computerized reference system has been developed for this collection and will be operational in FY 1985. Other technical documents are available through CNA's access to the Defense Technical Information Center and the resources of military libraries.

CNA's unclassified library houses a substantial collection of Congres sional documents, some 8,000 books, and a collection of more than 350 different journals. Access to outside collections and sources is provided

through the Library of Congress, interlibrary loan arrangements, and on-line bibliographic and text-retrieval services

## Computing Services

Through remote-access terminals and three VAX 11/780-85 computers, CNA analysts command a variety of languages, utilities, and application packages. The applications include word processing and graphics, in addition to a wide variety of scientific packages. Specialists provide data-management, processing, operating, and programming services.

## Publication Services

To turn out reports that are cogent as well as substantive, CNA provides analysts with the help of professional editors, graphics artists, and compositors. For fast turnaround, visual aids and documents are produced on CNA's own equipment.

In 1984, two major steps were taken to modernize CNA's publication equipment. A high-speed photocopier that affords even faster turnaround was installed, and an advanced composition system was ordered.

### SALARIES

The Senior Vice President and Department Directors approve all offers of employment and all actions affecting staff salaries. Any salary above the basic pay authorized for Level IV of the Senior Executive Schedule must also be approved by the CNA Board of Overseers and by the Navy's Contracting Officer. To make sure that CNA salaries are competitive, CNA's management analyzes salary survey data drawn from a large national sample of scientists and engineers by degree, specialty, and level of experience. This information is supplemented by informal exchanges with organizations conducting research similar to CNA's. Individual salaries and research accomplishments are reviewed every year.

### EQUAL OPPORTUNITY

CNA has long supported the principle of equal opportunity, regardless of race, creed, color, national origin, sex, age, physical handicap, or veteran status. To that end, CNA has established policies and practices in conformity with federal legislation. The main objectives of CNA's Affirmative Action Program are (1) to make sure that, within each sector of the labor market drawn on by CNA, minorities and women are represented on the CNA staff to the same degree as they are in the sector as a whole, and (2) to provide all employees with opportunities for training and advancement. CNA continues to be dedicated to these objectives.

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